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Mosquito News

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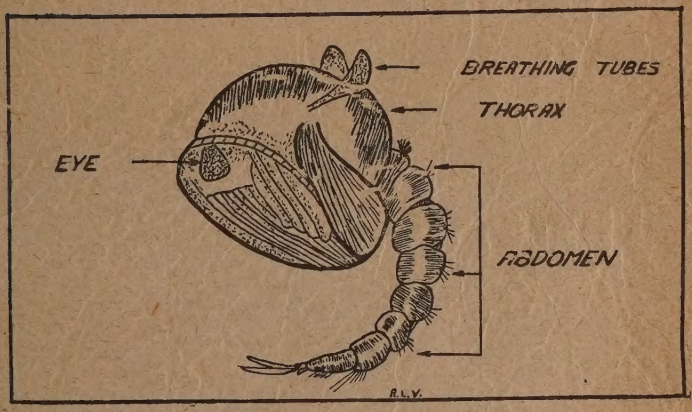

INDIAN MOSQUITO PUMPS

for

MOSQUITO CONTROL WORKERS

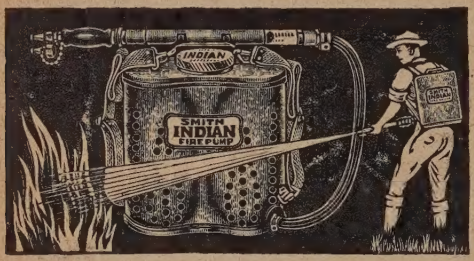

FIG. 1

Fig. 1. *SMITH INDIAN MOSQUITO PUMP*

is a 5-gallon galvanized tank equipped with double action pump and ADJUSTABLE NOZZLE. This outfit has a minimum of movable parts to wear or break. It is an ideal sprayer for both oil and pyrethrum larvicide spraying.

Fig. 2. Illustrates the ease in which the tank may be carried by hand, filled in the field and carried slung on the back, leaving the arms free to direct the spray or adjust the nozzle for long distant or fog mist.

The INDIAN MOSQUITO PUMP is highly endorsed for spraying for mosquito control work and many are in use for such purposes.

FIG. 2

WRITE FOR CATALOG

D. B. SMITH COMPANY

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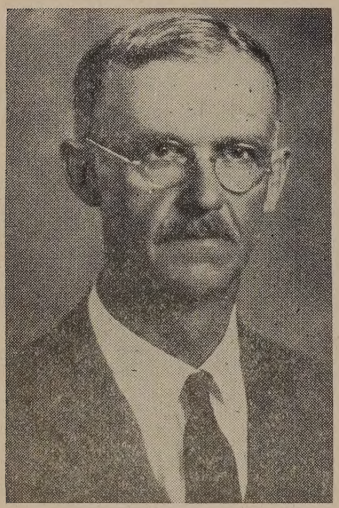
Eastern Ass'n of Mosquito Control Workers
New Brunswick, New Jersey

Contributions to this magazine should be mailed to C. T. Williamson, Chairman of Publication Committee, Mosquito News, Yaphank, N. Y.

JOSEPH AUGUSTIN LePRINCE



Mr. Joseph A. LePrince was born in England August 8, 1875. The LePrince family, when Joseph was six years old, came to New York City, and his mother became operator of a school of art.

The old mansion near 168th Street where the Medical Center now stands and which was then the LePrince home was surrounded by pastures over which Joseph and his younger brother roamed and enjoyed the boyhood of the usual youth.

At the time malaria was prevalent in the vicinity, and the younger LePrince often lost many days from school on account of chills and fever. Joseph never had the disease in New York but often prayed that he might take the disease so he could stay away from school like his brother.

Things went sufficiently well with the LePrince family so that Joseph was enabled to go to Columbia University and study civil engineering. He graduated in 1898. For some time after graduation he worked as a civil engineer with the mining interests in West Virginia.

Following the occupation of Cuba by the American forces in 1901 and the discovery of the mosquito transmission of yellow fever, Mr. LePrince seized the opportunity to accompany General Gorgas to Havana in an attempt to rid Havana of the scourge of yellow fever. The success of these men in eliminating that disease is too well known to require further mention.

At the conclusion of this work, Mr. LePrince went to Panama in 1904 with General Gorgas to control yellow fever and malaria on the Isthmus during the construction of the Canal. He remained there from 1904 to 1914, and the result accomplished there was a vivid demonstration that the white man could live and enjoy industrial prosperity in the fever ridden tropics.

Following his successful work on the Canal, Mr. LePrince joined the U. S. Public Health Service, and until his retirement in 1939 as Sanitary Engineer Director he was a living inspiration and example to every public health worker in the malaria field in our Southern States.

Mr. LePrince is a field man—no activity is too difficult, no assignment too arduous providing it offers an opportunity to promote health and comfort for the masses, and much of the excellent work accomplished in reducing mosquito-carried diseases is due to the sympathetic attitude and the example he gave to the waders in mud and swamps in mosquito control work. It was a recognized fact that Mr. LePrince seldom criticized. When conditions were bad and insurmountable obstacles were encountered, it was a pleasure to have Mr. LePrince appear on the scene. Troubles usually disappeared like magic as a result of his advice and suggestions.

A large part of Mr. LePrince's activity has been of a pioneering type—the development and adaptation to practice of new engineering methods for mosquito control. Thus he became known to the foremost mosquito and malaria control men throughout the world. Many of these have achieved success in the field of malaria control through the development and application of fundamental concepts laid down by Mr. LePrince.

(Continued on Page 119)

EDITORIAL SECTION

EDITORIAL COMMENT

Much emphasis has properly been put on mosquito control work from the disease elimination angle. Malaria is the most common disease carried by the mosquito in this country and a great deal has been accomplished toward conquering this plague. It is natural during time of war that the control of malaria should be uppermost in the minds of the Government Health Agencies. It is claimed that during the Spanish American War, malaria claimed more victims than enemy bullets. In this war where much of the fighting is taking place in malaria infected localities, the loss from this disease has been greatly reduced due to the efficient work of the army health officers.

However, at this time we wish to say a word in justification of control work from the pest elimination angle. In all those thickly populated states in the northern half of the United States there is a very small, if any, malaria problem. But there is a very important mosquito problem even in war times. With most of the population engaged in some kind of war work it seems to us that relief from the mosquito pest is of vital importance. The production of food is a prime necessity toward winning the war. There is no question but that if the Agricultural workers have to fight mosquitoes while they work their efficiency is greatly impaired at a time when the maximum effort is required. In addition there is the disease known as "Encephalomyelitis" which is carried by the common pest mosquito to horses which are still a very useful adjunct to the farm.

Long hours and tedious work have made war workers jittery enough without adding mosquito bites to the troubles of these home front soldiers. It is most disconcerting to work in a shop all day and come home to a restless night due to mosquitoes in the bedroom and on the front porch. One case is reported where it was necessary to shut down the entire plant due to mosquito annoyance and there must be many other cases of this pest entering manufacturing establishments.

For these reasons, while admitting that malaria control has first claim on our resources, we do not believe it good policy to neglect the control of mosquitoes from a pest standpoint but that all those northern organizations should be enabled to carry on with even more diligence than in times of peace.

THE EDITOR.

BUSINESS OF EASTERN ASSOCIATION

NEWS OF THE ASSOCIATION

Organization

The Association has continued to expand in gratifying fashion during the past few months and now includes members from all parts of the country, as well as from South America and Australia. Among the members in the armed forces are some in the Pacific war theatre while others are in the European area. The "News" goes to all of these, and it is to be hoped that it may be in some measure at least, helpful to them. Likewise, we may hope that military security regulations may sooner or later be relaxed sufficiently to allow some of these members in far places to give us accounts of their experiences.

Since the Association has become in fact a national group, it is anticipated that the able committee now studying the organization to determine how it can best serve the needs of its membership will have a definite proposal to place before it at the annual meeting which should be held sometime between now and the end of December. Should there be any members who have not had opportunity to express their ideas on this subject and who desire to do so, it is suggested that they write the secretary. In any event, it is believed that the changes to be proposed will provide maximum opportunity for cooperation with all existing organizations of mosquito workers and will aid in developing unity of thought in the advancement of mosquito work wherever it is needed.

Meetings and Inspections

The current season has seen the mosquito control agencies constantly on the firing line, not only combatting mosquitoes, but also shortages of labor, materials, transportation and equipment, while at the same time a number of the technical personnel were leaving to take up new duties with the federal services—all during a period when wartime requirements called for more, not less, mosquito control. With the active agencies striving with all their remaining resources to turn in a creditable performance in spite of these severe handicaps, there has been no doubt that any inspection or meeting during the summer months when mosquito breeding was at its apex would have been poorly attended. Now however, with the summer nearly over, perhaps it will be feasible to arrange to see some of the interesting new developments and accomplishments of the year.

Mosquito News

The hard working publications committee has been depleted by several of its members entering the federal services, thus leaving a tremendous load upon those remaining. To keep up the high standard that has been set for "Mosquito News" it will be necessary that the general membership continue and increase its support of the commtitee, by writing up and submitting for publication accounts of the newer and better things that are being done. The response to date has been good, but there doubtlessly are many developments that would be of general value if published but which are now serving only a limited field. Do you not have some such item, which you may take more or less for granted, but which would be of distinct service to the rest of us if we knew about it? Secretary.

WORLD WIDE MOSQUITO CONTROL

By Herman L. Felton
R.A. Sanitary Engineer (R)
U. S. Public Health Service
From Monthly Reports of Malaria Control in War Areas
Atlanta, Georgia

LARVICIDES AND THEIR APPLICATION

Part I —Contact Poisons—In January Report
Part II —Stomach Poisons—In February Report
Part III—Application of Larvicides—In February Report

Part I—CONTACT POISONS

The application of larvicides is the primary method of mosquito control used in the program Malaria Control in War Areas. Although this is somewhat contrary to the usual practice in normal malaria control operations in which main reliance is placed on control by drainage and filling, the emergency nature of this program and the temporary character of the establishments being protected, made it advisable to use larvicides to control mosquito production where effective control can be achieved by such measures.

Control by larvicides is based on the fact that the larval and pupal stages

of mosquitoes are spent in water and that during these stages the immature mosquitoes must rise periodically and penetrate the surface of the water with their breathing openings in order to obtain oxygen for respiration. The larvae, in addition, obtain their food from among the particles lying on the surface of the water, in suspension in the water, or on the bottom. Larviciding consists of the addition of toxic materials to the breeding waters so that the larvae and pupae will be killed in the performance of these functions.

There are, in general, two types of larvicides:

1. Contact poisons, which kill upon contact with the external and certain internal tissues of the insect.
2. Stomach poisons, which must be ingested to exert a toxic effect.

PETROLEUM OILS

Petroleum oils are the most widely used larvicides for mosquito control. The oil, sprayed over the surface of the water, forms a film there which serves to kill the larvae and pupae breeding underneath.

For best results the oil should possess the following properties:

1. It should readily penetrate the larval and pupal breathing openings and kill the larvae and pupae within a short time after application.
2. It should spread rapidly on the water surface in order to penetrate all the hiding places of the larvae and pupae and produce a uniform, unbroken film on the entire surface.
3. It should form a relatively stable film.

A mosquito larva or pupa, while in the process of breathing on the water surface, will also draw some oil from the surface film into its respiratory system through the breathing opening. The toxic effect then exerted varies with the type of oil used. Oils of low boiling range and high volatility exert a direct toxic action within a very short time. A high boiling, nonvolatile, heavy oil, on the other hand, may slowly cause death within one or two days. In order to be effective, the latter type of oil must be present as a continuous, unbroken film over the surface of the water for a considerable period of time; a condition almost impossible to insure under field operating conditions.

The ideal oil, then, should contain enough of a low boiling petroleum fraction to insure quick penetration into the respiratory system and high toxicity, and a sufficient quantity of a high boiling fraction to leave a relatively stable film. Such an oil would have the following specifications:

Type of Oil	Light Distillate fuel or Diesel
Gravity (A.P.I.)	27-33
Flash Point	130° or higher
Viscosity S.U.	
(a) 100° F.	35-40

Distillation:

10%: 430°-450° F.—(killing fraction)
50%: 510°-550° F.
90% 630° F. or higher—(lasting fraction)

These specifications are quite similar to those used by the Navy Department for their Diesel engine oil. The usual No. 2 fuel and Diesel oils are also satisfactory for the purpose.

The use of waste crankcase and similar oils has been found to be quite unsatisfactory. Such oils generally are not very toxic to mosquito larvae and pupae, spread poorly on the water surface and leave an unsightly mess. When mixed with kerosene and sprayed over the water surface, the effect is not much greater than would be produced by the same amount of kerosene used alone. The sludge, and other suspended particles in crankcase oils will clog

the nozzles of the sprayers so frequently that the average oiler will soon discard parts of the nozzle so that it will emit a solid stream rather than a spray of oil. Should it become necessary in any area to use waste crankcase oil, it should be collected and stored well in advance of use, so that the sludge and suspended matter will settle to the bottom and the relatively clear supernatant oil can then be drawn off for use.

Generally, from five to fifty gallons of oil per acre are required, depending on the method of application and the amount of vegetation, flotage, and debris. Less oil per unit area is required for the control of anophelines than for pest mosquitoes. Except in a densely overgrown area where larger quantities are necessary, no more than 25 gallons of oil per acre should be used for malaria mosquito control.

Advantages

1. Cheap (in normal times.)
2. Readily obtainable (in normal times.)
3. Can be stored indefinitely.
4. Is relatively long lasting.
5. Can be used in certain situations where pyrethrum-kerosene emulsion is not effective.
6. Is effective against the larvae and pupae of both anopheline and culicine mosquitoes, excepting **Mansonia perturbans.**

Disadvantages

1. Requires considerable storage space and is messy and bulky to handle.
2. Cannot ordinarily be applied at any considerable distance from the sprayer.
3. Spreads poorly in vegetation or debris; much of it is wasted on the surface of emergent vegetation when such is present.
4. Destructive to the rubber hose and gaskets of the sprayer unless special equipment is used.
5. Is often objected to by wild life interests.

PYRETHRUM-OIL EMULSION

Under certain circumstances, as in ornamental ponds, fish ponds and drinking water supplies where oil or paris green is objectionable, it may be desirable to use a pyrethrum-oil emulsion for control. By the addition of pyrethrum to the oil, it is possible to apply a considerably thinner film of oil to the water surface and still obtain a successful kill.

Pyrethrum powder is the ground dried flowers of the plant **Chrysanthemum cinerarea-folium.** The active toxic ingredient of these flowers is the pyrethrins content; this is generally extracted from the flowers in kerosene or light oil. The stock emulsion of the pyrethrum-oil emulsion, as developed at the New Jersey Agricultural Experiment Station, contains the following ingredients:

1. Six gallons of kerosene or light oil containing 1140 cc. or 40 ounces of 2% pyrethrum extract in light oil.
2. Three gallons of water.
3. Six ounces of an emulsifying agent, sodium lauryl sulphate (Gardinol W.A. Concentrated) which is commonly used, or 24 ounces of liquid 40% potash soap.

To prepare this emulsion, the emulsifying agent is added to the water, which is agitated until foam begins to form. The light oil, into which the pyrethrum extract has been introduced, is then slowly added to the water, while continuing the agitation. Very violent and sustained agitation is required for the formation of a suitable emulsion; agitation by hand is not usually very satisfactory. The resultant solution constitutes the concentrated stock emulsion in which form the material may be stored. Before spraying, the stock solution is diluted with ten parts of water to each part of emulsion. The diluted emulsion is then sprayed at the rate of about fifty gallons per acre, more or less, depending on the breeding place.

Advantages

1. Is not messy and is acceptable to many property owners where oil is not; for example, to control breeding in outdoor swimming pools.
2. Will not injure vegetation in ornamental garden pools.
3. Not injurious to fish or bird life as normally applied; consequently, more acceptable to wild life interests.
4. Acts much more rapidly than oil, and like oil, is effective against both anophelines and culicines.
5. Can be stored and carried into the field in concentrated form and diluted just before spraying.

Disadvantages

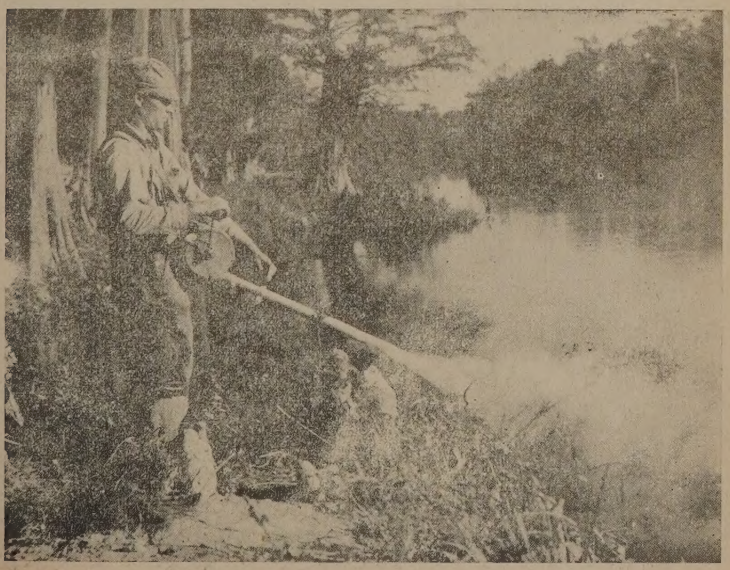
1. Relatively short lasting; quickly loses toxic effect after spraying.
2. Of no value on highly polluted breeding places; toxic effect of both pyrethrum and kerosene rapidly destroyed by high organic content of such places.
3. Special mixing apparatus and care are essential to form a good emulsion.
4. Deteriorates somewhat upon storage, losing some of its toxic qualities; emulsion is permanently destroyed if it is frozen.
5. We are dependent upon a foreign source of supply for pyrethrum.

PHENOL LARVICIDE

30 12-13

These larvicides are purchased as prepared commercially with varying phenol coefficient. A phenol coefficient of ten to fourteen has been found most suitable for mosquito control work.

The concentrated larvicide is diluted with thirty parts of water before spraying. Applied at rates varying from 10 to 95 gallons per acre, this material was found to be less effective than kerosene. In the laboratory, the larvicide applied at the rate of 50 gallons per acre killed 100 per cent of fish but only



HAND ROTARY DUSTER

16 per cent of larvae. It is therefore not recommended for general mosquito control.

PART II—STOMACH POISONS

Paris Green

Paris green (copper acetoarsenite) is the only stomach poison widely utilized in mosquito control work. It is used as a dust consisting of from one to fifty parts per hundred of paris green mixed with some inert diluent such as soapstone, hydrated lime, finely powdered talc, road dust, etc. The degree of dilution of the paris green should vary with the maximum distance that the limits of the breeding area lie from the point of liberation of the dust and with the width of lethal path desired. When it is required that the dust be effective against mosquito breeding at some considerable distance from the duster, a more concentrated mixture should be used, and the mixture should become progressively more dilute as the extent of necessary dust cloud coverage decreases. For example, hand casting can be used to dust a radius of about 20 feet from the duster and a one to two per cent paris green mixture (one to two parts paris green to 99 or 98 parts inert diluent) is recommended for this method of distribution. The mixture for use with a hand blower, effective up to 200 feet, should be five to ten per cent; for a power duster effective up to 500 feet, it should be ten to fifteen per cent, and for dusting from an airplane, 25 to 50 per cent.

The amount of paris green necessary per acre varies with the type of area being treated and successful results have been obtained with from one-quarter pound to two pounds per acre, and as high as four pounds where the water surface was thickly covered with water hyacinths. This refers to the actual quantity of paris green in the mixture. As an indication of the toxicity of this material to anopheline larvae and the minute amounts re-

AIRPLANE DUSTING

quired under ideal conditions, it has been found in the laboratory that an application of paris green equivalent to one-half ounce per acre would produce a mortality of 80 percent. In this connection it has also been found that the finer the particle size the more efficient the powder as a larvicide. In general, an application of approximately one pound of paris green per acre is satisfactory for anopheline control.

Paris green conforming to the following specifications is an effective larvicide: It should contain a minimum of 50 percent arsenious oxide, no more than 2½ percent being soluble in water. At least 95 percent should pass a 325 mesh sieve in a machine or hand shaking test without preliminary desiccation. Pan tests of the dust, in the same paris green-diluent mixture and the same rate of application as that to be used in the field, should give a complete kill on second, third, and fourth stage anopheline larvae in two hours.

Paris green is an arsenical compound and is, therefore, poisonous to warm blooded animals, including man. Due care must be taken when handling this material and every precaution should be taken to prevent the powder from entering the mouth or from accumulating in crevices in the skin. When dusting, the laborer should stand on the windward side of the duster. However, when applied in the minute quantities required for mosquito control, paris green has not been observed to have a poisonous effect on aquatic plants, live stock or other animal life; repeated applications do not appear to result in any cumulative effect of arsenical poisoning in the area treated.

ENGINE-DRIVEN CENTRIFUGAL PUMP

Advantages

1. May be applied to areas for anopheline control where application of liquid larvicides is not practical.
2. Use can be made of favorable wind currents to carry the dust cloud over an area otherwise inaccessible.
3. Can effectively treat areas covered with emergent vegetation.
4. Is easy to store and transport.

Disadvantages

1. When applied to the water surface as a dust, second, third, and fourth stage **Anopheles** larvae are killed but all pupae and many first stage larvae escape.
2. As used for the control of anophelines, paris green is not effective against the pest mosquitoes.
3. Difficult to use under adverse wind and weather conditions.

The importance of a knowledge of the biology of the various mosquito species is well illustrated in connection with the use of paris green. Culicine larvae hang head downward from the surface of the water and feed there at a subsurface level or at the bottom of the breeding place. Anopheline larvae, on the other hand, rest parallel to and just below the surface film of the water. In feeding, they set up small currents with their mouth parts which bring into their mouths any small particles lying on the surface. Paris green dust, which consists of very fine particles, settles and remains on the surface of the water, and is ingested by anopheline larvae with fatal results. Mosquito pupae take no food, and therefore are not affected.

PART III—APPLICATION OF LARVICIDES

Although the control of mosquitoes through the use of larvicides is superficially a simple matter, it requires a well coordinated organization calling

COMPRESSED AIR SPRAYER

for intelligent well trained inspectors, conscientious oilers or dusters and competent, energetic supervision. The effectiveness of larvicidal operations cannot be judged on the quantitative basis of oil sprayed or paris green dusted or the extent of water surface covered per man daily, but rather on the control of mosquito production achieved. This should serve as the criterion for judging the effectiveness of the program, although the efficiency factors should certainly not be disregarded.

Given effective toxic agents and an understanding of their uses and limitations, the success of a larvicidal program depends on the proper application of these materials to the breeding areas. Since water surface and breeding area are not synonomous, water surfaces in the zone under control must be divided into those which breed mosquitoes and those which do not. In addition, on this program, it is necessary to further differentiate areas which breed **Anopheles quadrimaculatus** or, in some areas, **A. maculipennis freeborni** or **A. albimanus.** The first requisites to an effective larvicidal program are, therefore, adequate entomological surveys and inspection.

The two most common faults of field larvicidal operations are: (1) overtreatment of the area in general, i.e., too heavy an application per unit area; and (2) undertreatment, or complete lack of treatment, of some portions of the area. The correction of these faults requires intelligent, energetic supervision at the breeding area being treated. To avoid double application to some spots and none to others, the larvicidal crew should be so organized that each man has a specific area to treat. The form of such organization would depend on the topography and whether oil or dust is being used. In larviciding extensive swamps the crew may be formed into a row, the men a certain distance apart and all moving forward together as they apply the larvicide. When the end of the breeding area has been reached, the row of men wheels on the outside man and again moves forward, treating the adjacent lane. When treating shoreline, ditches, or small isolated pools and ponds, each man may be assigned a specific segment to treat.

Overtreatment may be corrected by demonstrating to the members of each larvicidal crew just how much larvicide should be applied so that they can recognize overtreatment. They should be instructed to keep moving steadily as they are applying the larvicide. The foreman and other supervisory personnel should check the laborers frequently as they are working and correct them if necessary. It is a very natural impulse, even among high-type personnel, to apply a larvicide until its presence is clearly indicated on the surface. Overtreatment is indicated by a green color on the water when using paris green, a milky color when using pyrethrum-oil emulsion, or a strongly oily appearance when using oil.

Using knapsack or orchard type hand sprayers, one man may be able to distribute from 10 to 50 gallons of oil per day depending on the character of the area. If the water areas are fairly continuous and in open country, then the greater amount of oil can be sprayed. If the breeding spots are smaller and further apart and the underbrush is heavy, then it may be expected that an oiler will spray the minimum amount.

Similarly, using a hand rotary duster, the amount of dust that a laborer can distribute is conditioned by the nature of the terrain. Where breeding areas are continuous, or nearly so, and the going easy, one man may distribute 100 or more pounds of dust per day. Under adverse conditions, the distribution of 35 to 50 pounds of dust may represent a good day's work.

Methods of applying larvicides vary from such crude means as the hand casting of paris green to the use of airplanes for dusting or spraying. Hand casting of paris green or the application of oil or other liquid larvicides from a sprinkling can are methods which may be used where more efficient means are not available.

The most usual method of application involves the use of hand sprayers or dusters. Hand sprayers are of the compressed air or knapsack types. The compressed air sprayer differs from the knapsack type in that an actual pressure is built up within the tank, and the oiler must stop at fairly frequent intervals to build up depleted pressure in the tank. This type of sprayer has but one strap which is looped over a shoulder of the oiler. It is not a preferred type because of the frequent stops necessary for repumping and because any damage to the tank may destroy its usability. This sprayer has one advantage when being used on treacherous terrain where it is possible that the oiler may fall into the water or into a hole in the ground, since under such circumstances the one strap can be thrown off quite easily. When using this sprayer, it should not be allowed to stay in the sun for any considerable period of time without allowing the pressure to escape. During lunch time, and overnight, the pressure should be released.

There are three types of knapsack sprayers. The first and preferred type is that which has a piston type pump. The pumping handle in this type may be overhead or under the arm. The former is often preferred in open country, while the latter is generally more useful when working in dense underbrush or in wooded areas. The second type of knapsack sprayer has a diaphragm pump, which formerly was not very suitable for oiling because the rubber diaphragm quickly deteriorated when exposed to oil. It is understood, however, that manufacturers of this type of sprayer are now using a synthetic oil-resistant rubber and such sprayers may prove more satisfactory in the future. The third type of knapsack sprayer, originally developed for fighting forest fires, is the so-called trombone type, which has the pump in the handle just behind the nozzle.

Hand rotary blowers are used for the application of paris green dusts. These are similar to the blowers used for dusting agricultural crops. The paris green must be thoroughly mixed with the diluent before being applied to the breeding areas. This can be accomplished in a drum mounted on an eccentric shaft, which is turned by hand. There are also several power mixers on the market.

Power sprayers and power dusters, mounted in boats, airplanes or automotive equipment, can be used for the application of liquid and dust larvicides to the larger breeding areas. There are in general two types of power sprayers: namely, the high pressure piston type pump which draws the larvicide directly from the tank and sprays it over the breeding area; and the water-oil type that consists of an engine-driven centrifugal pump which draws a small portion of its discharge from the tank and the remainder from the breeding water. The latter type is always mounted in boats while the former may be mounted in motorcycles, trucks or boats.

Airplanes have been found very useful for the distribution of paris green dust over extensive breeding areas which could not otherwise be efficiently treated. Airplanes have not thus far proven very suitable for the distribution of liquid larvicides.

ACTIVITIES IN MEMBER STATES

AEDES AEGYPTI LINNAEUS, THE YELLOW FEVER MOSQUITO, IN CENTRAL MISSOURI

Reprinted from SCIENCE, January 2, 1942, Vol. 95, No. 2453, page 19.

Late in September mosquito larvae were found in a small aquarium in the office of the State Health Commissioner. These were taken to the Laboratory of the State Department of Health where, on October 4, 1941, an adult emerged that proved to be of this species.

This location, Jefferson City, is near the center of the state, about 38.6 degrees north latitude, and probably is the "fartherest North" for the species in Missouri.

C. F. ADAMS
Missouri State Department of Health, Jefferson City

A PRELIMINARY REPORT ON THE CULICIDAE (Mosquitoes) OF MISSOURI

By C. F. ADAMS, State Board of Health, Jefferson City, Missouri

Reprinted from the Proceedings of the Missouri Academy of Science, Vol 1 1934, Pages 77-80

The purpose of this article is to start a series of papers on the **Diptera** of this State. The **Diptera,** or two-winged flies, constitute one of our largest orders of insects, and one of the most important. The **Culicid**ae, or mosquitoes, come first to our attention largely through their public health relations, and it is deemed of economic value as well as of faunistic worth to submit the present list of species in this family of **Diptera** at this time.

Many species of mosquitoes are of wide distribution, some occurring not only all over this continent, but also in Europe and other parts of the world as well. As an example of these widely distributed forms, **Aedes vexans** (Meigen) may be mentioned. It has been found widely scattered in Europe, North America, Asia, the Philippines and elsewhere.

A generality of considerable interest is this: as we approach the North Pole, the number of species of mosquitoes decreases, but the number of specimens per species increases. And, of course, as we approach the Equator, the reverse holds true.

The number of species or kinds of mosquitoes in the world is not known, but a rough estimate of two thousand would probably be conservative enough—somewhat less than half of that number being found in the western hemisphere.

It is well known that the average locality in the United States should yield somewhere between twenty-five and thirty species of mosquitoes without being credited as a "mosquito" community. For instance, Ithaca, N. Y., has thirty-one species, and no one would designate that beautiful city as being infested with mosquitoes. The truth is only a few species become at all prevalent at times, the individuals of the other twenty-odd forms remaining very few in number. It is here estimated that somewhere between thirty-five and forty species ultimately will be found to occur in Missouri, and the following list is an approach to that end. Unless otherwise stated, all material was collected by the writer at Atherton, Jackson County, Missouri.

Megarhinus septentrionalis D. & K. A large tropical or sub-tropical form that has entered the State from the Southeast and has made its way as far north as Rankan, near St. Louis, where Dr. E. P. Meiners collected this material. This mosquito does not bite, altho its proboscis looks the part! Larvae live in tree holes, and sometimes in barrels and other artificial containers, where it is predaceous on other mosquito larvae.

Psorophora ciliata Fabr. (Gallinipper) With the foregoing, this is our largest mosquito, which is quite handy with its proboscis. Also tropical in origin, with larvae that live in transient rain pools. Eggs can withstand drying, even for three or four years.

As to the "remarkable" size of some mosquitoes, considerable myths obtain. The two species thus far listed in this paper are the largest found in this country. Any insect of larger proportions which the non-entomologist might mistake for a mosquito is in all probability a member of the **Tipulidae,** or crane flies—insects that look much like mosquitoes but belong to another family.

Psorophora sayi D. & K. Another biting form, but of smaller stature, whose larvae live in rain puddles. The winter is passed in the egg stage, which can withstand drying.

Psorophora discrucians Walker. Life history of this species is not very well known, but the larvae live in ground pools.

Psorophora cyanescens Coq. Develops rapidly in rain pools. Quoting

J. K. Thilbault: "The appearance of this mosquito immediately after rains is so strikingly characteristic that even people who never pay much attention to such things notice it. They are out in force for several days after a rain, and then only a few will be found till the next rain." Quoting Dyar: "It does not enter houses, but is very persistent out of doors, even in bright sunlight, and will often pursue a person. It is said to never quit biting voluntarily, but must be brushed off. Specimens have been seen on a horse for hours, voiding the surplus blood and sucking fresh." Additional specimens were collected at Hollister by Mrs. Vitae Kite.

Psorophora columbiae D. & K. A rather inoffensive mosquito whose larvae live in rain pools.

Culiseta inornatus Will. A large brown mosquito that is common all over the country, and prefers the larger mammals to man. The larvae live in permanent ground pools, and the winter is passed in the adult stage.

Culex restuans Theobald. This is our common house mosquito in the north. The larvae live in ground pools but will readily accept artificial receptacles.

Culex tarsalis Coq. Another common form that will enter houses. Its larvae are commonly found in grassy ponds and marshes.

Culex apicalis Adams. A form that is unusual in its colorational character, the white cross bands being at the apices of the abdominal segments instead of the base—hence the name **apicalis.** The original specimen of this species was collected in Arizona, but this mosquito has since then emigrated to all parts of North America, Europe and the Levant. It is quite harmless to man, preferring such cold-blooded animals as frogs and snakes.

Culex pipiens Linn. Another globe-trotter that is something of an annoyance in houses at night. The larvae live mostly in artificial receptacles. Dr. E. P. Meiners has taken additional specimens at Rankan, Mo.

Culex quinquefasciatus Say. This is the common house mosquito of the South. It has been accused of transmitting Dengue fever, but later students have gone to its defense in that regard.

Aedes trivittatus Coq. The larvae prefer ground pools that are the result of flood water, particularly in river valleys. The adults frequent bushes and trees. Mrs. Vitae Kite has collected additional specimens of this mosquito at Hollister, Missouri.

Aedes triseriatus Say. Larvae live in tree holes, and the winter is passed in the egg stage. Females are severe biters, but never abundant except at times in dry woods.

Aedes nigromaculis (Ludl). A form that is more common in the dryer regions in the west of us. Rather severe biter, and at times becomes relatively abundant.

Aedes vexans Meigen. This is the commonest woods mosquito throughout the country. The females are severe biters, but do not frequent the open. The males swarm in large groups after sunset. The winter is passed in the egg stage.

Uranotaenia sapphirina O. S. A small but very pretty mosquito that seldom bites. Upon superficial glance, the larvae resemble those of **Anopheles.**

Anopheles quadrimaculatus Say. Our chief malaria transmitter. The larvae are surface feeders, especially in permanent pools in relation to rivers. The winter is passed by the fertilized female. Very difficult to differentiate between this species and **A. maculipennis,** common on west coast.

Anopheles punctipennis Say. A malaria carrier, but not so active in that regard as the foregoing species.

Eight additional species have been reported from Missouri by other collectors, but the nineteen forms here listed are the only ones examined by the author.

ANOPHELINES IN BROOKLINE, MASSACHUSETTS

Norman S. Stearns
and
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Acknowledgment: To Norman S. Stearns for his great assistance in the field work, all of the identification, and for writing the following paper.

To the Inspectors and Field Crew Members of the Division for their interest and hard work in collecting specimens.

Brookline is a semi-urban town 6.82 square miles in area located just outside the City of Boston. Its population of about 53,000 is for the most part concentrated in the northerly portion of the town leaving many acres of land that are rural in nature.

In a survey made of the mosquitoes of Brookline from July 15 to September 10, 1942, larvae of Anopheles quadrimaculatus were found in 8 breeding places, out of 110 locations from which specimens were taken for identification. An average of 3 collections per day was made by the regular Inspectors and Field Control workers of the Division of Fly and Mosquito Control, Brookline Board of Health, following an orderly inspection route of eight "mosquito districts" into which the town is arbitrarily divided.

By knowing what mosquitoes were present, and where, in 1939 (State Survey) and what mosquitoes were present, and where, in 1942 (Brookline Survey), it is possible to arrive at some important conclusions. As regards Anopheles quadrimaculatus in Brookline, it is apparent that this species of mosquito prefers clean clear water to polluted water. More striking is the fact that of the 8 breeding localities in which anophelenes were found in 1942, 5 or 70% bred anophelenes in 1939. The continued recurrence of anophelenes and more specifically of **A. quadrimaculatus** in the same breeding areas after a lapse of 3 years might be considered as an indication that hibernation occurs and that particular localities offer special advantages for such an occurrence.

The first specific breeding place was an ornamental garden fish pool in the rear of a large hotel located in the most densely populated section of the town. The hotel's garage adjacent to the pool was, before the war, more often than not, crowded with out-of-town cars, many bearing license plates of Tennessee, Mississippi and other malaria states. The significance of this fact is emphasized by an appreciation of the role of common carriers in relation to the spread of insect transmitted diseases. Some 600 yards from this pool was another breeding place, a pond, in which anophelenes bred early in the season before control measures were applied. However, when the pond's shore line and vegetation were altered and when such natural predators as turtles, toads, goldfish, and Gambusia affinis were introduced few culex and no anophelenes were found despite repeated personal inspections.

A third important breeding place was a group of large ornamental fish pools in the geographical center of the town. Originally swamp land, efforts were made to fill in the area but these and other clear water pools have persisted. Anophelenes were found in the vicinity in 1910 (Board of Health Report), in 1939 (State Survey) and again in 1942 (Brookline Survey).

As regards the remaining breeding places, all might be called private ornamental pools.

This study has shown the value of comparative surveys and has emphasized the need for control work in advance of the mosquito breeding season in particular localities known to favor anophelene breeding and hibernation. Further, the repeated occurrence of anophelene breeding in private fish ponds in urban Brookline supplements the findings of Perry W. Ruth as reported in **Mosquito News** for December 1942. This fact is worthy of particular consideration by all control workers in similar areas. There are 496 private ornamental pools listed in Brookline.

CAIRO MOSQUITO ABATEMENT DISTRICT

By Donald A. Miller, President of the Board of Trustees

THE CAIRO MOSQUITO ABATEMENT DISTRICT is now completing its third season of its existence. It covers an area of approximately eight square miles, including the city of Cairo and surrounding communities. The city of Cairo is situated on an isthmus formed by the junction of the Mississippi and Ohio Rivers and is almost surrounded by the rivers. The rivers at this point are each a little less than one mile wide. Across the rivers are low swampy lands which make ideal breeding places for mosquitoes. In spite of this fact, however, the Cairo District has succeeded in almost annihilating the mosquitoes, except for an early Spring crop which hatches and develops in the swamp areas across the rivers and migrates to Cairo. This crop is purely a pest mosquito, but very annoying, and gives rise to considerable unfavorable comments at the time. If anyone reading this article knows of a method of prevention of this, your suggestions will be greatly appreciated.

The annual budget calling for the maximum amount of taxes which can be levied by the District totals $4,000, from which levy the District receives approximately $3,000. With this revenue we have purchased a ¾-ton panel-body truck for hauling equipment and men about the District, and a motorcycle with sidecar attached, which has been fitted with a 60-gallon pressure tank into which has been fitted a metal innertube valve and a sprayer, hose, and nozzle. The tank is filled about half full of the spraying solution and air pressure applied at a filling station, and the motorcycle is then driven about the streets, used for the purpose of spraying sewer catch basins and such places as are readily accessible from the motorcycle. Other more inaccessible places are covered by means of knapsack sprayers.

Waste crankcase oil is obtained at no cost from the filling stations and diluted with kerosene in the ratio of one part of kerosene to four parts of oil. This makes a very inexpensive, yet efficient, larvicide. For places where oil might be injurious to fish or plants a pyrethrum larvicide is used. We employ three men full time during the mosquito season, with extra help as needed during the wet periods.

Statements from the local doctors indicate a marked decline in the number of cases of malaria since this Abatement District has been organized, so we feel that the effort is worthwhile.

DONALD A. MILLER,
President, Board of Trustees.

MOSQUITO ABATEMENT OPERATIONS
GREAT LAKES NAVAL TRAINING STATION
Great Lakes, Ill.

S. D. ANDERSON,
Lieut. Comdr., U.S.N.R., Station Security Officer

During the period from Dec. 7th, 1941 to the fall of 1942 the Great Lakes Naval Training Station boundaries were extended some two miles nearer to a swampy area lying south and west of the station. Other low spots lay within the Station boundaries and along the railroads and highways in the surrounding country.

A survey of the area was made by Station Officers and a program outlined early in the spring of 1943. Permission to drain low spots was obtained from all property owners involved and ditching and grading operations were started within the station area and in the immediate vicinity as soon as the ground became workable.

A considerable amount of tilling was done within the Station boundaries but open ditches only were constructed outside. Ditching machinery being only intermittently available the bulk of the work was done by hand digging. Crews of approximately fifty recruits in training were assigned to the duty; each crew working a day or two only, as a part of their physical hardening program.

Some hundred odd acres of swamp land in three or four sections were

completely drained and were thoroughly dried up early in the summer. Other ponds were cleaned around the margins and stocked with minnows.

Ravines were cleaned, dumps where tin cans had been accumulating over a period of years covered, and a great many spots where casual water collected eliminated.

A small truck was fitted with an oil drum pump and spray equipment. A few pack-back sprayers were acquired and the stand-by sections of the Station Fire Department organized as abatement crews. Used crank case oil of which there was a considerable quantity available was mixed with thinner oil and spraying operations started when larvae began to appear in such pools as remained.

No attempt was made to trap and identify the various species of mosquitoes present in the area. Results obtained from the drainage and spraying operations, however, have been highly satisfactory as the number of mosquitoes has been tremendously reduced in comparison with previous years.

Property owners, the railroads, and the Illinois State Highway Departments were most cooperative. Invaluable advice was furnished by the personnel of the Lake Forest Abatement District whose territory lies just south of the Great Lakes area.

DEVELOPMENTS IN MOSQUITO CONTROL

NON-DRUG ASPECTS OF MALARIA CONTROL

By J. Lyell Clarke, Sanitary Engineer
The Des Plaines Valley Mosquito Abatement Dist.
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In this article three recently developed phases of malaria control are emphasized as applicable to the war effort: mechanized equipment, outdoor spraying of repellants, and aniline dye dusts. An attempt has been made to show where these new methods fit into the picture of malaria control.

Reports from the Philippines, from China, Burma, India, the Southwest Pacific and Africa describe malaria as an even more disabling disease than we know it to be in North America.

Forty years ago medical men pictured malaria as a chain of three links, and reasoned that if any one of the links could be broken the disease would be conquered.

The first link consisted of the parasite in man. They reasoned that if a drug could be found to kill the parasite in man the first link of the chain would be broken.

The second link consisted of eradication of the malaria carrying mosquito. They reasoned that if mosquitoes could be exterminated in a city or county no new cases would develop; and so the second link of the chain would be broken.

The third link consisted of separating man and mosquito. They reasoned that actually, it would not be necessary to kill the parasite in man, nor would it be necessary to kill the mosquito; but simply devise a means of keeping the mosquito from biting man.

Inasmuch as the severing of any one link would suffice, the medical man embarked enthusiastically upon breaking the first link with quinine. It cured many cases but not quite all. Always, beneath the apparently healed surface there remained a telltale, tantalizing irreducible minimum reservoir of parasites that made the first link to appear like rubber to stretch but not to break. Other drugs were tried but all were found wanting because of the hidden reservoir of parasites and the involved human equation. Drugs are a godsend to individual sufferers but as a chain breaker it is a disappointment.

The breaking of the second link was assigned to the engineer and the entomologist because they working together could ferret out and destroy the breeding of the mosquito by drainage and the spraying of chemicals and oils. In large cities mosquito control is most satisfactory from the viewpoint of cost

and comfort and in small cities it is well within economical limits. The second link in the chain of malaria has been broken in a thousand cities. Success is limited to communities leaving the second link unbroken in rural areas.

Another method of breaking this second link (killing the mosquito) is so simple and unpretentious that after discovery and successful use it was allowed to lapse and then to be discovered again recently in a new form. The plan consisted of swatting infected mosquitoes, not hapahazardly by individuals, but according to plan. It yielded wonderful results. Recently an insecticide has been used to replace the swatter. This improved method may be called species control of infected mosquitoes. It is a cheaper and quicker means of breaking the second link and applicable under field conditions where supplies of repellants are too limited to carry on outdoor protection with high-pressure spraying units.

The third link in the chain of malaria transmission, the separating of man and mosquito, is the one that has received the least attention. Around this link revolves success or failure of conspicuous results in control among the military forces.

This link can be broken by separating man and mosquito by screening, by applying mosquito repellant hand lotions, and by spraying of outdoor mosquito repellents.

During World War I, for the first time in war history the second link of the chain of malaria transmission was broken by drainage of mosquito breeding places in and around military camps; and too, a great deal of attention was given to screening of barracks in order to break the third link.

During World War II drainage and screening are being continued on an even larger scale; and to this gain is being added double or vestibule door screening, and even bed-nets inside barracks; and this latter is supplemented by spraying of insecticides in barracks twice nightly. Indoor protection may not be overworked because these multiple checks and balances are necessary when dealing with the human element. However there is a form of protection which is being sadly neglected. Persons working outdoors at night, as individuals or groups, should be given protection in a manner as thorough as those sleeping indoors.

Individuals in mosquito ridden regions are being furnished with mosquito repellent hand lotions for the first time in war. This is a simple but glorious step forward and should be pressed to the limit.

There is another step that has not been taken which offers dramatic results. Comfort and disease prevention for groups working outdoors may be provided by fog-spraying of liquid repellents. In malarial regions men are required to change to long clothes and leggings at night. This protection is not sufficient, the principle protection at night should be the spraying of outdoor repellents.

Machinery suitable for this service is described in "Mechanized Mosquito Control: Puddle Jumper, Swamp Angel, Dinosaur, Skeeter-Eater, and Corner Cutter" published in the Proceedings of the New Jersey Mosquito Extermination Association in 1942. Pictures of this machinery in operation will appear during September 1943 in Life Magazine describing mosquito control in the Des Plaines Valley Mosquito Abatement District. This machinery is also used for routine application of mosquito larvicides.

The four-wheel-drive units used by the military forces of the Jeep type may be converted into marsh buggies by turning the disk wheels outward in order to provide body clearance for the large 1350 x 24 tires.

Military units are equipped with decontaminators which may serve as sprayers of mosquito larvicide and mosquito repellent. A camp site could be cleared of mosquitoes within one hour. This protection will last for 24 hours at least. However large wheel marsh buggies are needed for marsh spraying.

THIS TREND OF THOUGHT WOULD LEAD TO THE CONCLUSION THAT IF A DISEASE CAN BE PREVENTED BY THE USE OF MECHANICAL EQUIPMENT BETTER THAN IT CAN BE CONTROLLED BY DRUGS THERE SHOULD BE NO HESITATION UPON THE PART OF ANY DE-

PARTMENT, CIVIL OR MILITARY, TO GRANT APPROPRIATIONS FOR THE PURCHASE OF MECHANICAL EQUIPMENT.

IN A CIVILIAN POPULATION OF 100,000 MOSQUITOES CAN BE CONTROLLED FOR 25c PER CAPITA PER YEAR; IN A MILITARY AREA THE COST SHOULD BE LESS. HUMAN LIFE CAN NOT BE MEASURED IN DOLLARS AND CENTS ESPECIALLY WHERE IT INVOLVES THE NATION'S MOST PRECIOUS POSSESSION, THE YOUTH OF OUR COUNTRY.

ANILINE DYE DUSTS

In far flung projects in the tropics where new species of mosquitoes are encountered, or species of which the habits are little known, aniline dye dusts may be used to study flight range, longevity and other habits.

At present the Des Plaines Valley Mosquito Abatement District is carrying on a series of staining experiments to determine the day-to-day movements of mosquitoes in a limited area, following the initial long flight immediately after emergence of a brood at a marsh, takes place.

This method of staining is described in the Proceedings of the New Jersey Mosquito Extermination Association, 1937, under "New and Significant Experiences in Mosquito Control in the Des Plaines Valley Mosquito Abatement District," also in the 1943 Proceedings of the New Jersey Mosquito Extermination Association entitled "Flight Range and Longevity of Mosquitoes Dusted with Aniline Dye."

CRUDE OIL USED FOR MOSQUITO CONTROL

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Crude oil is being used successfully for the control of mosquitoes at the U. S. Naval Air Training Center, near Corpus Christi, Texas.

According to Ginsburg and Rudolfs (1941)*, the ideal mosquito oil should contain enough of a low boiling petroleum fraction to insure quick penetration into the tracheal system and rapid kill of larvae and pupae; and a sufficient quantity of a high-boiling fraction to leave a lasting film.

Tests were made on this oil and the results as compared with the "ideal oil" as recommended by Ginsburg and Rudolfs are as follows:

	Ideal Oil	Crude oil used by U. S. N. A. T. C.
Type	Distillate fuel	Crude - distillate
Gravity (A.P.I.) 60° F.	27 - 33	42.5
Flash	130° F. or higher	100° F.
Viscosity at 100° F.	35 - 40	34
Odor	none offensive	same
Distillation	90% at 630° 10% at 430° - 450° F. 50% at 510° - 550° F.	590° F. 444° F. 497° F.

This crude oil is obtained from an oil company adjacent to the Naval air Station and offers the solution to our mosquito oil problem. The oil is highly toxic to the larvae and pupae, spreads rapidly and has a lasting film on either the fresh or saline water that is present.

For the distribution of this oil, a decontamination unit, that was not being used by the Chemical Warfare Department, was adapted for mosquito control. The unit consists of a solution tank, pump, and motor. The tank is constructed of wood with steel rims. It has a five hundred gallon capacity. The three cylinder pump operates under a recommended pressure of 400 pounds

MOSQUITO CONTROL

and will deliver 35 gallons of liquid per minute with a normal speed of 150 strokes per minute. Thus, one-half hour to one hour is all that is required to discharge a complete tank of oil when the unit is in operation. The motor has four cylinders and will deliver 16-22 horsepower. The unit also contains a continuous pressure reel which holds the 200 feet of ½ inch rubber hose, along with an assortment of nozzles. When the unit is operating at a 400 pound pressure, a stream of oil can be sprayed for over 150 feet. The entire unit is mounted on sled runners and transported by means of 6-wheel drive Tandem truck.

DITCHING WITH DYNAMITE FOR MOSQUITO CONTROL

By J. I. HORTY
The Explosives Engineer, Wilmington, Delaware

Individuals and organizations whose duties involve the control of pestiferous and disease-inflicting mosquitoes are confronted with many problems in making new ditches and/or deepening, widening, and cleaning existing ditches. The Government has had to commandeer practically all new and used excavating equipment for use in military construction projects. The manpower situation is such that hand labor is almost unobtainable. It is highly probable that these two conditions will exist for some time after the war is over.

It has been proved time and again that dynamite, which is available in wartime, will do cheaper and faster work in digging open ditches in wet or marshy ground than can be done with labor, and picks, and shovels. Not only have landowners learned the economy and speed of dynamite for dig-

ging open ditches; the Government also has used it in military cantonment and airfield construction work. County engineers, drainage engineers, the United States Public Health Service, county health commissions, railroad companies, state and county highway departments, and contractors, have employed explosives successfully in ditching through marsh, swamp, and woodland.

In reporting on ditching work in Public Health Bulletin No. 104, Mr. W. D. Tiederman summarizes his experiences in ditching with dynamite as follows:

"1. It is possible to dig a ditch through land filled with roots and stumps, removing stumps at the same time the ditch is opened.

2. It is possible to open a ditch in ground that is too boggy to be shoveled.

3. There are no large spoil banks along the line of ditch, as the dirt is scattered broadcast.

4. A ditch of almost any size desired may be opened.

5. The work is done very quickly.

6. Little labor is required, which is a big item today.

7. The work is more agreeable to laborers, and they can be held much longer.

8. The cost is much less than handwork."

When a ditch is dug by hand or machine, the earth is piled up along the sides, forming spoil banks. These prevent the easy flow of water from the fields into the ditch, and the banks cover land which cannot be tilled. Dynamite, instead, scatters the earth on each side of the ditch, leaving no spoil banks.

A blasted ditch is usually two to three times as wide as it is deep and side slopes are one to one. The action of the explosive force is in a cone shape; when a series of charges is detonated for ditch blasting a V-shape ditch is expected. However, it is possible to blast a ditch of desired bottom width by placing the charges at certain depths.

Some people think it is necessary to clean the ditch by machinery or hand after the blast. If the charge is of the correct size and is placed properly, in most instances, there is no extra work required after the blast. The few clods of earth that fall back into the ditch will soon be broken up and washed away by the flow of the water.

Blasting may be done with satisfactory results through ground so soft that there is no footing for horses and no support for wheels. It can be accomplished when the surface of the ground is under water.

The size of the charge and the method of blasting will vary with the moisture content of the soil. Dynamite has often finished ditches that were too wet and rough for a drag line and too small for a floating dredge.

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PERSONAL NOTES

DR. CHARLES C. ADAMS RETIRES

Having reached the statutory retirement age of 70 years, Dr. Charles C. Adams retired on July 31st after having served for 17 years as Director of the New York State Museum. Dr. R. D. Glasgow will be Acting in Charge pending the selection of a new Director to succeed Dr. Adams.

Before coming to the New York State Museum in 1926, Dr. Adams had been professor of Zoology at the New York State College of Forestry at the University of Syracuse, Syracuse, N. Y., since 1914. While at the State College of Forestry Dr. Adams brought about the organization of the Roosevelt Wild Life Forest Experiment Station of which he was Director until he left to become Director of the New York State Museum.

Before his appointment as Professor of Zoology at the State College of Forestry, Dr. Adams had held the position of Assistant in Biology at Illinois Wesleyan University (1895 to 1896), Assistant Entomologist, Illinois State Laboratory of Natural History (1896-1898), Curator of the University Museum, University of Michigan (1903-1906), Director, Museum of the Cincinnati Society of Natural History (1906-1907), and Associate in Animal Ecology, University of Illinois (1908-1914).

Dr. Adams received his Bachelor of Science Degree at Illinois Wesleyan University in 1895, the Master of Science Degree at Harvard in 1898 and the Ph.D. Degree at the University of Chicago in 1908. From his early interest in Entomology. Dr. Adams later turned to Animal Ecology, a field to which he has contributed books and many scientific articles.

Dr. Adams' address for the time being will continue to be 149 Manning Boulevard, Albany, N. Y.

August 23, 1943
ROBERT D. GLASGOW.

NEW MOSQUITO FILM

There is now available for general showing a new 16 mm. sound motion picture on malaria and malarial mosquito control. This is entitled "Winged Scourge" and was made by the Walt Disney Studios for the Office of the Coordinator of Inter-American Affairs. After showing graphically the ruin that can overtake the farmer in a malarious area, the beloved seven dwarfs appear and make short work of exterminating the quadrimaculatus. Entertaining as well as instructive, this film is sure to be well received at any showing to the public. This film may be secured at a very nominal fee from The Princeton Film Center, Princeton, N. J., as well as other distributing centers of O.W.I. films.

JOSEPH AUGUSTIN LePRINCE

(Continued from Page Ninety-Four)

And so as great as was Mr. LePrince's work in Cuba and on the Isthmus of Panama, it is far outweighed by the tremendous stimulation he has been for the past twenty-five years to workers in all malarious areas both at home and abroad, and to the cause of malaria control throughout the world.

Mr. LePrince's attitude in life has been to make the world a better place in which to live. This he has accomplished, and with his retirement from active work with the Public Health Service in 1939, a distinct loss of an active leader is sensed by everyone engaged in the control of insect-carried disease.

Mr. LePrince married while stationed in Cuba and has four daughters and a son.

Though now retired from active service on account of age, Mr. LePrince from his home in Memphis, Tennessee, still takes an active interest in the problems of insect-carried disease and in the new conditions that confront mosquito control workers as a result of the war.

By H. A. JOHNSON
August 31, 1943

DIRECTORY OF AGENCIES ENGAGED IN MOSQUITO WORK

Following the publication of Volume 3 Number 2, certain corrections and additions to the directory have been received. These are given below. Readers are requested to report any other errors or omissions in the 1943 directory so the new issue to be published in 1944 may be complete and accurate. (Sec.)

Australia

Council for Scientific and Industrial Research, The Librarian, Division of Economic Entomology, P. O. Box 109, Canberra City, A.C.T., Australia.

Bolivia

Institute of Inter-American Affairs, Servicio Cooperativo Inter-Americano de Salud Publica, Dr. George C. Bergman (Major. A.U.S.), Chief of Party; Captain Anthony J. Kranaskas (A.U.S.), Sanitary Engineer, c/o American Consulate, Cochabamba, Bolivia.

Brazil

Institute of Inter-American Affairs, Servico Especial de Saude Publica, Dr. H. G. Baity, Acting Party Chief and Chief Engineer, c/o American Embassy, Rio de Janeiro, Brazil.

Colombia

Institute of Inter-American Affairs, Servicio Cooperativo Inter-Americano de Salud Publica, Dr. Howard B. Shookhoff, Chief of Party; Captain Lewis A. Young (A.U.S.) Sanitary Engineer, c/o American Embassy, Bogota, Colombia.

Costa Rica

Institute of Inter-American Affairs, Servicio Cooperativo Inter-Americano de Salud Publica, Dr. Thomas B. Phinizy, Chief of Party; Mr. John L. Hummel, Sanitary Engineer, c/o American Embassy, San Jose, Costa Rica.

Ecuador

Institute of Inter-American Affairs, Servicio Cooperativo Inter-Americano de Salud Publica, Lt. Wyman R. Stone (A.U.S.) Associate Chief of Party and Sanitary Engineer, c/o American Embassy, Quito, Ecuador.

El Salvador

Institute of Inter-American Affairs, Servicio Cooperativo Inter-Americano de Salud Publica, Lt. Col. H. W. Van Hovenberg (A.U.S.) Sanitary Engineer, c/o American Embassy, San Salvador, El Salvador.

Guatemala

Institute of Inter-American Affairs, Servicio Cooperativo de Salud Publica, Dr. Robert L. Vought (Major, A.U.S.) Chief of Party; Mr. Samuel T. Drew, Sanitary Engineer, c/o American Embassy, Guatemala City, Guatemala.

Haiti

Institute of Inter-American Affairs, American Sanitary Mission, Mr. Ralph S. Howard Jr., Chief of Party, c/o American Embassy, Port-au-Prince, Haiti.

Honduras

Institute of Inter-American Affairs, Servicio Cooperativo de Salud Publica, Dr. I. Frank Tullis (Captain, A.U.S.) Chief of Party; Captain Peter C. Karalekas (A.U.S.) Sanitary Engineer, c/o American Embassy, Tegucigalpa. Honduras.

Panama

Institute of Inter-American Affairs, Servicio Cooperativo de Salud Publica, Brig. Gen. Morrison C. Stayer (U.S.A.) Representative of the Institute of Inter-American Affairs; Mr. Howard D. Schmidt, Chief of Party and Chief Engineer, c/o American Embassy, Panama City, Panama.

Peru

Institute of Inter-American Affairs, Servicio Cooperativo de Salud Publica, Dr. Edward A. Westphal (Major, A.U.S.) Chief of Party; Captain Benjamin A. Whisler (A.U.S.) Sanitary Engineer, c/o American Embassy, Lima, Peru.

U. S. Government and Washington Offices

Coordinator of Inter-American Affairs, Division of Health and Sanitation, General George C. Dunham, Director, Major H. B. Gotaas, Chief, Engineering Section, Commerce Department Building, Washington, D. C.

Venezuela

Institute of Inter-American Affairs, Oficina Cooperativa Inter-Americana de Salud Publica, Lt. Col. Ernest W. Steel (A.U.S.) Chief of Party and Chief Engineer, Apartado 74, Maracay, Venezuela.

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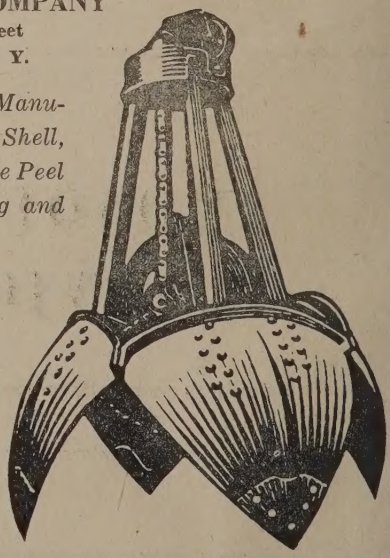

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